Time Value of Money (Interest Rate) & Cash Flow

Engineering Economic Analysis Section
Perancangan Pabrik Kimia 2

Schedule

- **Time Value of Money (Interest Rate) & Cash Flow**
- Depreciation & Salvage Value
- Profitability Analysis
- Selection of Alternatif Investment of Chemical Plant Equipment
- Sensitivity/Break Even Analysis
- Tax Principals (Dasar-Dasar Perpajakan)
- Selection of Plant Location
- Ujian Modul

Back View

- You have studied about Fixed Capital, Manufacturing Cost, Working Capital, etc.
- **Economic evaluation** can be carried out to determine:
  - The process generates money
  - The process is attractive compared with other process
- **Money ?????**
  - Consume money as received
  - Retain money for future consumption
    - Simple saving
    - Investments

Interest Rate ("Bunga")

- Interest rate is the ratio of the interest charged at the end of a period (usually 1 year) to the amount of money owed at the beginning of the period ==> percentage
- Interest may be compounded on basis other than annual ==> may be monthly basis
- Other similar terms but not the same as: DCFROR, ROI

Simple Interest

- The interest is charged on the original loan and not on the unpaid balance
- $F = P + Pin = P(1 + in)$
- F: Future value of money; P: present value of money; i : interest rate; n : number of interest period
- Example: If $1000 has been borrowed at 10% simple interest for 4 years, how much money will be owed for 5 years?
  - End of year 1: 1000 + (1000*0.1*1) = 1100
  - End of year 2: 1000 + (1000*0.1*2) = 1200
  - and so on....

Compound Interest ("Bunga Majemuk")

- Interest ==> has a time value
- $F = P (1 + i)^n$
- Year 1: $F_1 = P + Pi = P (1+i)$
- Year 2: $F_2 = P + P(1+i)i = P(1+i)^2$
- Year n: $F_n = P(1+i)^n$
- Nominal interest: an interest rate is quoted on an annual basis
- However, interest may be payable on a semiannual, quaterly, monthly, or daily basis
- ==>

Nominal Interest

- Formula:
- $$F = P\left[1+\left(\frac{i}{m}\right)\right]^{(m)(n)}$$
- where: m : the number of interest periods per year; n: the number of years; i : the nominal interest

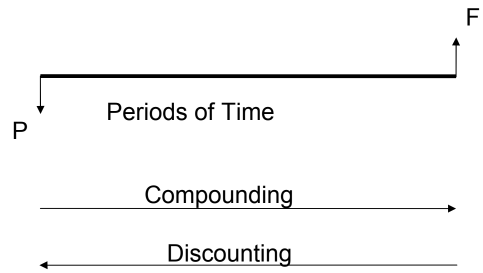
Example:

- If we have \$2500 were invested for 5 years at 10% nominal interest compounded quaterly, what would be the future amount?

  $$F = P\left[1+\left(\frac{i}{m}\right)\right]^{(m)(n)}$$

  - F=(\$2500)[(1+(0.1/4))$^{(5)(4)}$] = (\$2500)(1.025)^{20} = \$4096.54
- If the interest were compounded monthly, the future amount would be:
  - F=(\$2500)[(1+(0.1/12))$^{(12)(5)}$] = \$4113.19
- If the interest had been compounded on a daily basis, then:
  - F=(\$2500)[(1+(0.1/365))$^{(365)(5)}$] = \$4121.73

Compound Interest Factors



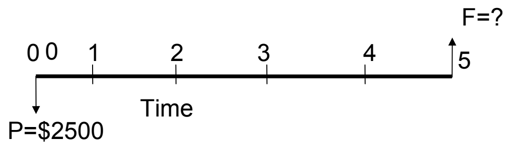
- Compounding: the proces of moving money forward in time
- Discounting: The process of moving money backward in time
- The periods are in years, and the interest is normally on an annual basis.

Discount Factor Table

Conversion	Symbol	Common Name	Formula
P to F	(F/P,i,n)	Single Payment Compound Amount Factor	$(1+i)^n$
F to P	(P/F,i,n)	Single Payment Present Worth Factor	$1 / (1+i)^n$
A to F	(F/A,i,n)	Uniform Series Compound Amount Factor, Future Worth of Annuity	$\frac{(1+i)^n - 1}{i}$
F to A	(A/F,i,n)	Sinking Fund Factor	$\frac{i}{(1+i)^n - 1}$
P to A	(A/P,i,n)	Capital Recovery Factor	$\frac{i(1+i)^n}{(1+i)^n - 1}$
A to P	(P/A,i,n)	Uniform Series Uniform Series Present Worth Factor, Present Worth of Annuity	$\frac{(1+i)^n - 1}{i(1+i)^n}$

Examples of Discount Factors

- If \$2500 were invested at 5% interest compounded annually, what would be the balance in the account after 5 years?
  - F=? ; P=\$2500; i=5% = 0.05; n=5;



  - $F = P(F/P,i,n)=P(1+i)^n=(2500)(1+0.05)^5 = \$3190.70$

Examples...

- A person desires to borrow \$18500 now to be paid back in 10 years at 8.5% compounded annually. How much is this person required to pay annually?
  - P=\$18500; i=0.085; n=10 years; A = ?
  - $A=P(A/P,i,n)= P\,[(i(1+i)^n) / ((1+i)^n-1)]$
  - $A = (\$18500)\,[(0.085(1+0.085)^{10}) / ((1+0.085)^{10})-1)]$
  - A = \$2819.50

Effective Interest Rates

- Nominal interest rates as noted previously are on an annual basis, but effective interest rates may be for any period
- Effective interest rate:

$$i_{eff} = \left[1 + \frac{i}{m}\right]^{m} - 1$$

- Example: 8.33% interest rate compounded monthly. What is the effective interest rate?
  - ieff = (1 + (0.083/12))(12)(1) – 1 = 0.0865 atau 8.65%

Capitalized Cost

- The capitalized cost method is a present analysis in which the economic life of an asset or venture is considered indefinitely long
- Perpetuity: an annuity in which the periodic payments continue indefinitely
- Capitalized Cost is defined as the original cost of the equipment plus the present value of the renewable perpetuity:

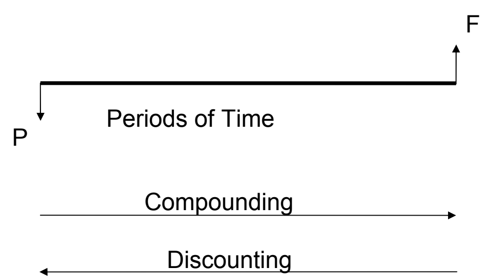
$$K = C_V + \frac{C_R}{(1+i)^n - 1}$$

- K : capitalized cost; C_V: the original cost; C_R: the replacement cost, and i: interest rate, and n: interest period
- $C_R = C_V - SV$ (where SV: Salvage Value)

Example: Capitalized Cost

- A new piece of completely installed equipment costs $12,000 and will have a scrap value of $2000 at the end of its useful life. If the useful-life period is 10 years and the interest is compounded at 6 percent per year, what is the capitalized cost of the equipment?
  - The cost for replacement of the equipment at the end of its useful life = $12000 - $2000 = $10000 ==> C_R
  - Capitalized cost (K) = $C_V + C_R / ((1+i)^n-1)$
  - C_V=$12000; i=0.06; n=10
  - K = ($12000) + ($10000/((1+0.06)^{10}-1) = $24650

CASH FLOW CONCEPT



Money Flow of a Company

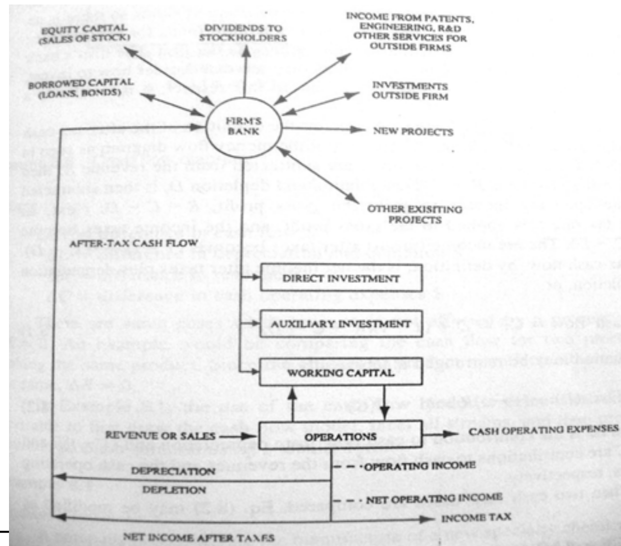
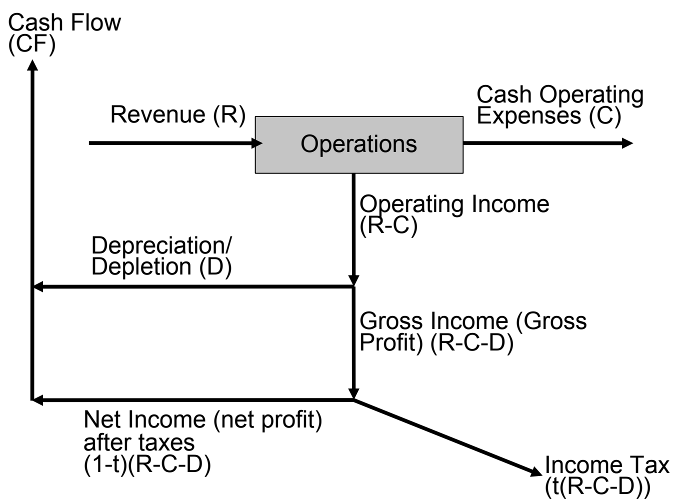


FIGURE 8.4 Money flow diagram for a company.

Concept of Cash Flow



Cash Flow = D + (1-t)(R-C-D)

Cummulative Cash Flow

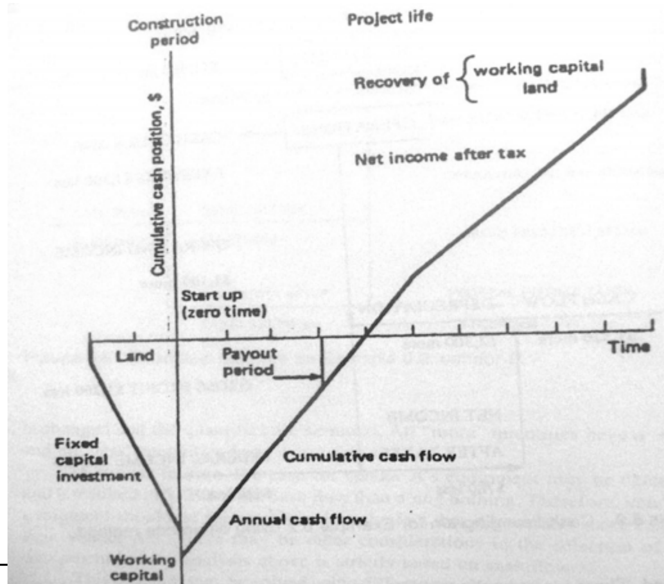
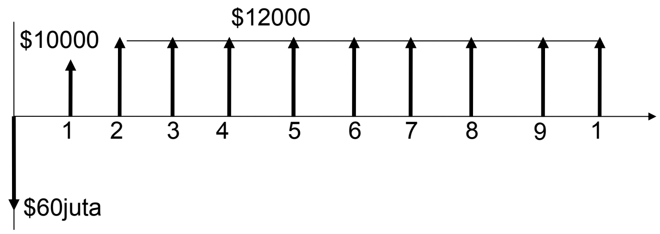


FIGURE 8.10 A typical cumulative cash position plot.

Example:

- Sebuah perusahaan berkeinginan menginvestasikan sejumlah uang untuk sebuah projek pabrik kimia. Besarnya aliran kas (cash flow) setelah pajak adalah:
  - investasi awal = \$60juta
  - cash flow after tax pada tahun ke-1 = \$10juta
  - cash flow after tax pada tahun ke-2 hingga ke-10 = \$12
  - Jika internal discounted rate of return adalah 10%, maka:
    - Gambarkan cash flow diagram
    - Hitunglah Net Present Value (NPV)
    - Hitunglah Future Worth

- Cash flow Diagram:



- NPV = [-$60 + $10(P/F,0.1,1) + $12(P/A,0.1,9) (P/F,0.1,1)] x 1juta
- NPV = [-$60 + ($10)(1/(0.1+1)) + [($12)((($0.1+1)^9$- 1)/(0.1($0.1+1)^9$))][1/($0.1+1)^9$]
- NPV = $11.9 juta
- Hitunglah untuk Net Future Worth